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10/826,007	04/16/2004	Hongxing Tang	CIT.PAU.46	9207

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EXAMINER	
BONANTO, GEORGE P	

ART UNIT	PAPER NUMBER
2855	

DATE MAILED: 12/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/826,007	TANG ET AL.	
	Examiner	Art Unit	
	George P. Bonanto	2855	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 December 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16 and 20-41* is/are pending in the application.

4a) Of the above claim(s) *2,3,9,24,25 and 31* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-8,10-16,20-23,26-30 and 32-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 November 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *4/28/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Claims 2, 3, 9, 24, 25, and 31 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected species, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on 13 December 2005.

Applicant's election with traverse of species 4 in the reply filed on 13 December 2005 is acknowledged. The traversal is on the ground(s) that Figures 3a and 3b are directed to the same species. This is not found persuasive because, as is made clear by the specification at lines 2-4 on page 11 of the specification, Fig. 3b depicts a parallel array circuit while Fig. 3a depicts a single wire circuit in a serpentine form (note that line 4 on page 11 contains a typographical error, "Fig. 3b" should read "Fig. 3a"). Nevertheless, as no claims appear to be directed to species 3, Applicants enumeration of the claims directed to elected species 4 and generic claims appears to be correct

The requirement is still deemed proper and is therefore made FINAL.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Specification

The disclosure is objected to because of the following informalities: at line 10 of page 6, the word "and" should be deleted and the word "an" should be inserted in its place.

In addition, as noted above, at line 4 of page 11, the phrase, "Fig. 3b" should be deleted and the phrase, "Fig. 3a" should be inserted in its place.

At line 2 of page 15, the phrase "they represent a significant amount materials used" contains a grammatical error.

At line 10 of page 15, the phrase, "the signal appear" contains a grammatical error.

At line 2 of page 19, the phrase, "Fig. 8" should be deleted and the phrase, "Fig. 6" should be inserted in its place.

At line 14 of page 21, the phrase, "B y" should be deleted and the word "By" should be inserted in its place.

At lines 22-23 of page 22, the phrase, "than that in silicon integrated circuits" should be deleted and the phrase, "than that of silicon integrated circuits" should be inserted in its place.

Appropriate correction is required.

Claim Objections

Claims 1, 8, 20, 23, and 30 are objected to because of the following informalities: the phrase "of the order" should be deleted and the phrase "on the order" should be inserted in its place. Appropriate correction is required.

Claim 29 is objected to because of the following informalities: claim 29 contains a grammatical error. Appropriate correction is required.

Claims 30-32 are objected to because of the following informalities: claim step "providing the thin metal film" lacks antecedent basis. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 4, 6-8, 10-12, 14, 15, 20-23, 26, 28-30, 32-34, 36, and 37 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,882,051 to Majumdar et al.

As to claims 1, Majumdar et al. disclose a piezoresistive wire having a cross sectional area of the order of 100 nm^2 or less (piezoresistive nanowire with a cross-sectional area of $(10\ nm)^2$; col. 27, line 55) and means for measuring resistance change in the piezoresistive wire in response to transverse force applied to the piezoresistive wire (col. 34, line 50 to col. 35, line 5).

As to claim 4, Majumdar et al. further disclose a flexure element and where the piezoresistive wire comprises an embedded piezoresistive wire in the flexure element (sheath 16; Fig. 2, or partial COHN with coating on one side; col. 34, lines 60-62).

As to claim 6, Majumdar et al. further disclose a flexure element and where the piezoresistive wire comprises an array of piezoresistive wires embedded in the flexure element (array of piezoresistive nanowires in matrix; Fig. 31).

As to claim 7, Majumdar et al. further disclose that the piezoresistive wire comprises a thin metal film (nanowire made from Au; Fig. 12).

As to claim 8, Majumdar et al. further disclose that the thin metal film comprises a film with a thickness of the order of tens of angstroms or less (5 nm diameter for entire nanowire, col. 12, line 19).

As to claim 10, Majumdar et al. further disclose that the thin metal film comprises a pure metal composition selected from the group of Au, Cr, Ag, Pd, Ni, Pt, Mn and alloys, Au-Ni, NiCr, Bi-Sb, Ag-Ni, Cu-Ni, and Pt-Cr (pure Au, Fig. 12).

As to claim 11, Majumdar et al. further disclose that the piezoresistive wire comprises a thin metal film included on a bimorph structure comprised of a top later comprised of the thin metal film and a bottom layer comprised of a higher resistive metal layer than the top layer, a semiconductor layer, or an insulating layer (col. 34, lines 59-64).

As to claim 12, Majumdar et al. further disclose that the piezoresistive wire comprises doped crystalline silicon (doped crystalline silicon segments Fig. 3).

As to claim 14, Majumdar et al. further disclose that the piezoresistive wire comprises doped GaAs (col. 13, lines 14-22).

As to claim 15, Majumdar et al. further disclose that the piezoresistive wire comprises doped $Ga_xAl_{1-x}As$, where $0 < x < 1$ (col. 15, line 23).

As to claim 20, Majumdar et al. disclose a flexure element (sheath 16; Fig. 2) a piezoresistive wire embedded in the flexure element, the piezoresistive wire having a cross sectional area of the order of $100nm^2$ or less (nanowire 14 with diameter of 5 nm; col. 12, line 19) and means for measuring resistance change in the piezoresistive wire in response to a transverse force applied to the piezoresistive wire (col. 34, line 50 to col. 35, line 5).

As to claim 21, Majumdar et al. further disclose a plurality of piezoresistive wires forming an array of embedded piezoresistive wires in the flexure element (array of piezoresistive nanowires in matrix; Fig. 31).

As to claim 22, Majumdar et al. further disclose that the piezoresistive wire comprises a thin metal film included in a bimorph structure comprised of a top layer comprised of the thin metal film and a bottom later comprise of a higher resistive metal layer than the top layer, a semiconductor layer or an insulating layer, doped crystalline silicon, doped silicon carbide, doped GaAs, doped $Ga_xAl_{1-x}As$, where $0 < x < 1$, or a doped AlGaN/GaN, AlN/GaN/InN or GaN/AlN/GaN heterostructure (col. 34, lines 59-64).

As to claim 23, Majumdar et al. disclose a method of measuring strain at nanoscales comprising providing a nanowire strain gauge comprised of a piezoresistive wire having a cross sectional area of the order of 100 nm^2 or less (piezoresistive nanowire with a cross-sectional area of $(10\ nm)^2$; col. 27, line 55) stressing the piezoresistive wire with a force having a transverse component (col. 35, lines 2-4) and measuring resistance change in the piezoresistive wire in response to the transverse component of the force applied to the piezoresistive wire (col. 34, lines 54-56).

As to claim 26, Majumdar et al. further disclose providing a flexure element in which the piezoresistive wire comprises an embedded piezoresistive wire so that stressing the piezoresistive wire comprises stressing the flexure element (col. 34, lines 59-64).

As to claim 28, Majumdar et al. further disclose providing a flexure element and where the piezoresistive wire further comprises an array of piezoresistive wires embedded in the flexure element (array of piezoresistive nanowires in matrix; Fig. 31).

As to claim 29, Majumdar et al. further disclose that the nanowire strain gauge comprised of a piezoresistive wire comprises a thin metal film (nanowire made from Au; Fig. 12).

As to claim 30, Majumdar et al. further disclose that the tin metal film has a thickness of the order of tens of angstroms or less (5 nm diameter for entire nanowire, col. 12, line 19).

As to claim 32, Majumdar et al. further disclose that the thin metal film comprises a pure metal composition selected from the group consisting of Au, Cr, Ag, Pd, Ni, Pt, Mn, and alloys Au-Ni, NiCr, Bi-Sb, Ag-Ni, Cu-Ni, and Pt-Cr (pure Au, Fig. 12).

As to claim 33, Majumdar et al. further disclose that the piezoresistive wire comprises a thin metal film included in a bimorph structure comprised of a top layer comprised of the thin metal film and a bottom later comprised of a higher resistive metal layer than the top layer, a semiconductor layer or an insulating layer (col. 34, lines 59-64).

As to claim 34, Majumdar et al. further disclose that the piezoresistive wire comprises doped crystalline silicon (doped crystalline silicon segments Fig. 3).

As to claim 36, Majumdar et al. further disclose that the piezoresistive wire comprises doped GaAs (col. 13, lines 14-22).

As to claim 37, Majumdar et al. further disclose that the piezoresistive wire comprises doped $Ga_xAl_{1-x}As$, where $0 < x < 1$ (col. 15, line 23).

Claims 39 and 40 are rejected under 35 U.S.C. 102(b) as being anticipated by "Atomic resolution with an atomic force microscope using piezoresistive detection" by Tortonese et al.

As to claim 39, Tortonese et al. disclose a device comprising a cantilever (Fig. 2a) a metal thin film piezoresistor located on the cantilever (Fig. 2a) and a detector which is adapted to

measure a resistance change in the piezoresistor in response to a force applied to the cantilever (Fig. 1 and page 1, col. 2).

As to claim 40, Tortonese et al. further disclose that the cantilever comprises a notched nanocantilever (Fig. 2a) and the metal thin film piezoresistor is located on arm portions of the nanocantilever adjacent the notch (Fig. 2a).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 5 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,882,051 to Majumdar et al., as applied to claims 1 and 26 above, in view of "Atomic resolution with an atomic force microscope using piezoresistive detection" by Tortonese et al.

As to claims 5 and 27, Majumdar et al. fail to explicitly disclose that the flexure element comprises at least one arm in a notched nanocantilever.

Tortonese et al. disclose a strain gauge with a piezoresistive wire embedded in a flexure element where the flexure element comprises at least one arm in a notched nanocantilever (Fig. 2a).

It would have been obvious to one of ordinary skill in the art to modify the nanowire strain gauge of Majumdar et al. by including the notched nanocantilever flexure element of

Tortonese et al. in order for the piezoresistive wire to occupy the most highly stressed region of the flexure element (Tortonese et al. at page 1, col. 2, lines 3-4).

Claims 13 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,882,051 to Majumdar et al., as applied to claims 1 and 23 above, in view of U.S. Patent No. 3, 034,345 to Mason.

As to Majumdar et al. fail to explicitly disclose that the piezoresistive wire comprises doped silicon carbide.

Silicon carbide is a well known semiconductor substrate that can be used for making piezoresistive elements as is disclosed, for example, by Mason (col. 7, lines 42-47).

It would have been obvious to one of ordinary skill in the art to modify the nanowire strain gauge of Majumdar et al. by using the doped silicon carbide of Mason in order to make the nanowire more thermally stable than the silicon substrate of Majumdar.

Claims 16 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,882,051 to Majumdar et al., as applied to claims 1 and 23 above, in view of U.S. Patent No. 6,784,074 to Shchukin et al.

As to claims 16 and 38, Majumdar et al. fail to explicitly disclose that the piezoresistive wire comprises a doped AlGaN/Gan, AlN/GaN/InN or GaN/AlN/GaN heterostructure.

Shchukin et al. disclose a GaN/AlN/ GaN heterostructure (col. 12, lines 55-58).

It would have been obvious to one of ordinary skill in the art to modify the nanowire strain gauge of Majumdar et al. by using the GaN/AlN/GaN heterostructure of Shchukin et al. in order to eliminate defects from the epitaxial layers (Shchukin et al. col. 4, lines 30-40).

Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over "Atomic resolution with an atomic force microscope using piezoresistive detection" by Tortonese et al., as applied to claim 39 above, in view of "Polymer-based stress sensor with integrated readout" by Thaysen et al.

As to claim 41, Tortonese et al. disclose that the metal thin film piezoresistor is located adjacent to a base of the cantilever, but fail to explicitly disclose that the cantilever comprises a biofunctionalized cantilever and the detector is adapted to detect binding of a biological analyte to the cantilever.

Thaysen et al. disclose a biofunctionalized cantilever that is adapted to detect the binding of a biological analyte to the cantilever (page 1, col. 2, first full paragraph).

It would have been obvious to one of ordinary skill in the art to modify the device of Tortonese et al. by including the biofunctionalized cantilever of Thaysen et al. in order to be able to detect when molecules are immobilized onto the surface of the cantilever (Thaysen et al.; page 1, col. 2, first full paragraph).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. Patent No. 6,887,365 and Published U.S. Application Nos. 2002/0166962; 2005/0214803; 2003/0135971; 2005/0244326; 2005/0236357 and 2005/0275502 disclose various piezoresistive nanowire or cantilever systems and manufacturing methods.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to George P. Bonanto whose telephone number is (571) 272-2182. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Lefkowitz can be reached on (571) 272-2180. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

GPB

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PRIMARY EXAMINER